REMARKS

This amendment is to place the application in better form for an early allowance. Reconsideration and allowance of all claims is requested.

April 6, 2005 Interview

The applicants express their appreciation to Examiner Trieu for the courtesy of a telephone interview on April 6, 2005. At the interview, a newly proposed claim was discussed, along with the differences between the present vacuum pump and method relative to the prior art of record. The discussed claim has been rewritten in light of the Examiner's comments and is now presented as claim 48.

The Status of the Claims

Claims 1-27 and 43 stand allowed.

Non-elected claims 28, 29, and 30 have been cancelled.

Claims 31-34, 39-42, 44, and 45 which stand rejected under 35 U.S.C. § 102 as being anticipated by Ozawa (US 5,549,463) are represented herein with the independent claims amended.

Dependent claims 35-38 46, and 47 stand rejected as being obvious over Ozawa. The independent claims from which these dependent claims depend have been amended.

New claims 48-52 are presented.

The Prior Art

Ozawa discloses a two-stage vacuum pump. The inlet side stage is a roots pump stage with intermeshing rotors **2, 3**. The roots pump stage compresses suction gas from an inlet (not shown, or at least not labeled) into a connecting channel **81**. The channel **81** is typically called a "dead volume". The roots pump stage compresses gas into the dead volume without internal compression, because the channel **81** is roughly closed and opened. Thus, a large amount of high compression power is utilized.

On the other side of partition wall **8** are a pair of screw rotors **5, 6**. The screw rotors receive the suction gas from the dead volume or connecting channel **81** and move the suction gas along the screw rotors to an exit port **33**.

Thus, Ozawa discloses two discrete pumping stages which are separated by a partition wall **8**.

The Ozawa two-stage vacuum pump has an inlet side pump stage without internal compression, which is roughly closed and opened versus the outlet side pump stage. Accordingly, it has a low power consumption only when the inlet pressure is very low, *e.g.*, near about 1 mbar.

The Present Application

By distinction, the suction section of the inlet side pump defined between the male portion **142** and the female portion **152** in FIGURE 3 passes the suction gas directly into a corresponding helical channel defined between the helical threads or teeth. See, for example, FIGURE 13 where the helical channels between the helical threads **244, 270** connect directly with a corresponding female portion. Thus, the inlet suction section and the screw pump section are located adjacent and are always open to each other. By distinction, the chambers of the roots pump of Ozawa and the helical channels of the helical pump stage of Ozawa transfer the suction gas into and out of channel **81** respectively.

The always open and direct interconnection between the pumping stages of the present application increases the intake volume. That is, when the male portion opens the inlet, suction gas is drawn into not only the female portion but a part of the directly connected helical groove, thus increasing the intake volume. With continued rotation, the male portion closes the inlet and the male and female portions compress the suction gases directly into the helical groove.

Due to this inner compression, the pump has a lower power consumption when the internal pressure is high, *e.g.*, 200 mbar or higher. Such a condition is especially desirable when the vacuum is applied as a load lock pump. The pressure inside the load lock chamber which is pumped to a vacuum changes frequently from atmospheric pressure to a final vacuum pressure as the chamber is opened and closed for loading new material processes.

With continued rotation, the helical threads and grooves move the compressed suction gas along the screw suction stage to the exit port.

Enclosed Exhibits A, B, and C are illustrative of the relative power savings. Exhibit A illustrates a single stage, *e.g.*, screw thread, pump with constant volume compression operating at about 200 mbar. Exhibit B is illustrative of the Ozawa pump, operating with an inlet pressure of about 200 mbar. Exhibit C is illustrative of the vacuum pump of the present application in which the first stage provides internal compression and the second stage constant volume compression with an inlet pressure of 200 mbar. In each of the Exhibits, the hatched areas are equivalent to the power needed for moving a unit volume of suction gas per unit time from the inlet opening to the exhaust opening. The red-dash crossed section region of Exhibit C is illustrative of the power saving relative to the Ozawa pump.

The Claims Distinguish Patentably Over the References of Record

Claims 1-27 stand allowed.

Claim 31 calls for the lobe and channel of the inlet suction stage and the first and second helical threads of the screw suction stage to be disposed within a common chamber. By distinction, in Ozawa, the roots pump and screw pump are disposed in different pumping chambers, which pumping chambers are separated by partition **8**. Further, claim 31 calls for suction gas to be trapped as the inlet portion closes in the suction section between the lobe and channel as well as a portion of a directly connected helical groove. The trapped suction gas is directly compressed into the helical groove of the screw section defined by the rotor threads and grooves and is transported to the exhaust port. By distinction, in Ozawa, suction gas drawn into the roots pump is trapped only in a corresponding section of the roots pump and not into a portion of the helical grooves of the screw pump. Ozawa compresses the gas from the roots pump into the connecting channel **81**, then later moves the compressed gas from the connecting channel **81** into the grooves of the screw pump stage.

Because Ozawa neither teaches nor suggests these limitations nor the savings in power attributable thereto, it is submitted that **claim 31 and claims 32, 35, 36, 37, 38, and 42 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 39 calls for the suction section to be in direct communication with the screw section. By contrast, in Ozawa, the roots pump and the screw pump each intermittently connect with the passage **81**, but do not connect directly with each other. Accordingly, it is submitted that **claim 39** distinguishes patentably over the references of record.

Claim 40 calls for a common pump chamber. First and second shafts are disposed in the common pump chamber. A lobe and channel are defined on the shaft adjacent an inlet port to form a positive displacement suction section in the common pump chamber. Also in the common pump chamber, first and second rotors are disposed on the shafts extending from the lobe and channel to an exit port.

Claim 40 calls for these two pumping sections to be disposed in a common pump chamber; whereas, Ozawa separates its two stages into two different pump chambers.

Claim 40 further calls for the two pump sections to be in direct communication. By distinction, the two stages of Ozawa each interconnect with a channel or dead volume, but do not connect directly with each other.

Because Ozawa does not show the claimed limitations nor achieve the reduction in power attributable thereto, it is submitted that **claim 40 and claim 33 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 41 calls for a pair of rotors and male and female portions which define at least two pumping or suction sections within the same chamber. By distinction, the two stages of Ozawa are disposed in separate sections. Accordingly, it is submitted that **claim 41 and claim 34 dependent therefrom** distinguish patentably and unobviously over the references of record.

Claim 43 stands allowed. Claim 44 now depends from claim 43.

Claim 45 calls for a method for reducing power to remove a volume of gas through a vacuum pump. Helical threads define a screw section and a lobe and channel define a suction section. After suction gas is received through the inlet port and the inlet port is closed trapping the suction gas, the suction section directly compresses the suction gas into the screw section. By distinction, in Ozawa, the root section compresses the gas into channel **81**. Ozawa does not suggest direct

compression of the suction gas into the screw section. Accordingly, it is submitted that **claim 45 and claims 46-47 dependent therefrom** now distinguish patentably and unobviously over the references of record.

New claims 48-51 call for two sections in the same pump chamber. By distinction, in Ozawa, the roots pump and the screw pump are in separate chambers.

New **claim 52** is presented to claim the inventive concepts more completely.

Telephone Interview

The undersigned would be pleased to discuss the claims with the Examiner in order to expedite an early allowance of the present application.

CONCLUSION

For the reasons set forth above, it is submitted that claims 1-27 and 31-52 distinguish patentably and unobviously over the references over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

Respectfully submitted,

FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

Thomas E. Kocovsky, Jr.
Reg. No. 28,383
1100 Superior Avenue
Seventh Floor
Cleveland, OH 44114-2579
(216) 861-5582

one stage

Gilh CONSTANT VOLUME COMPRESSION $P_i = \sim 200$ mbar

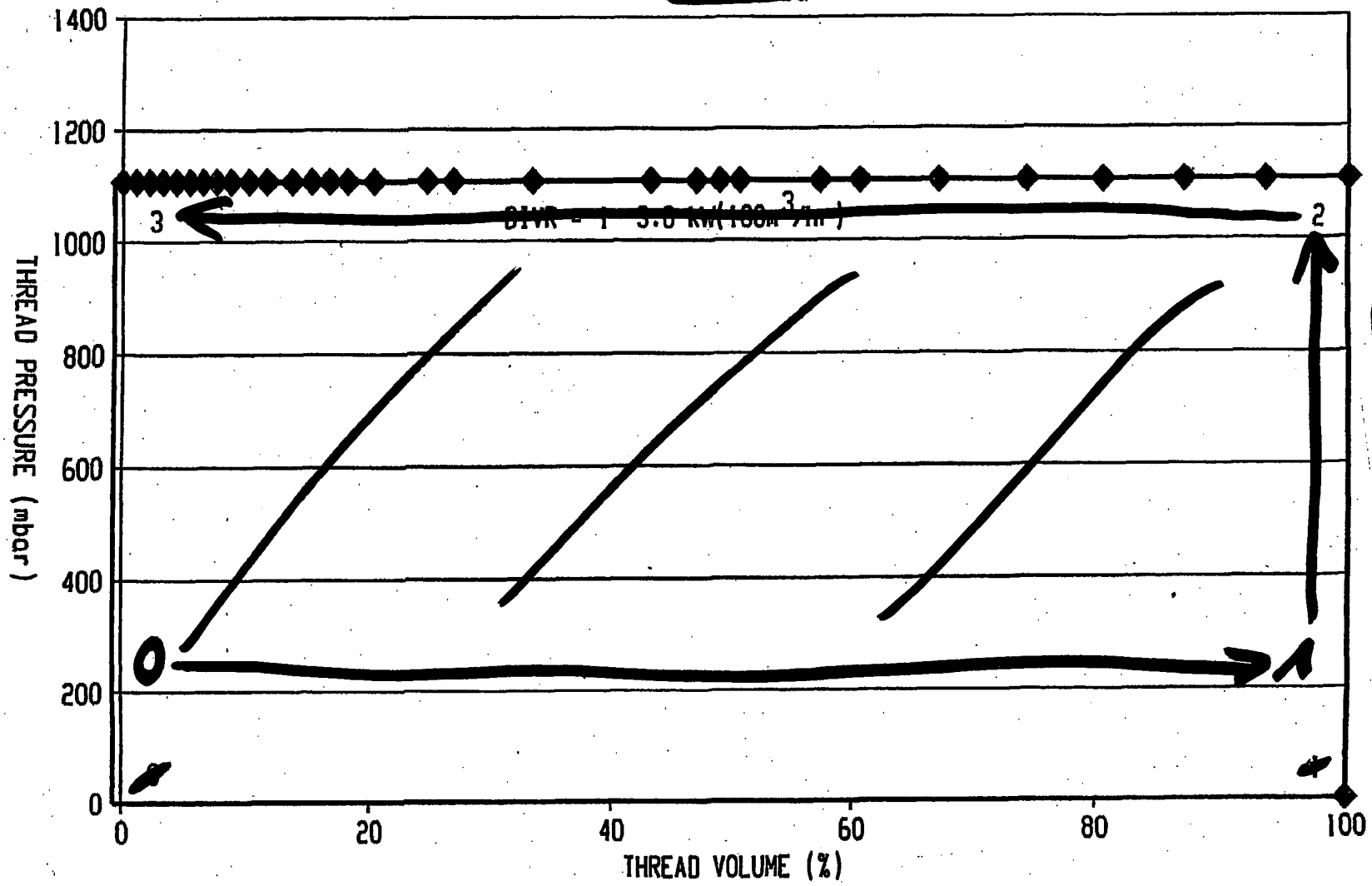
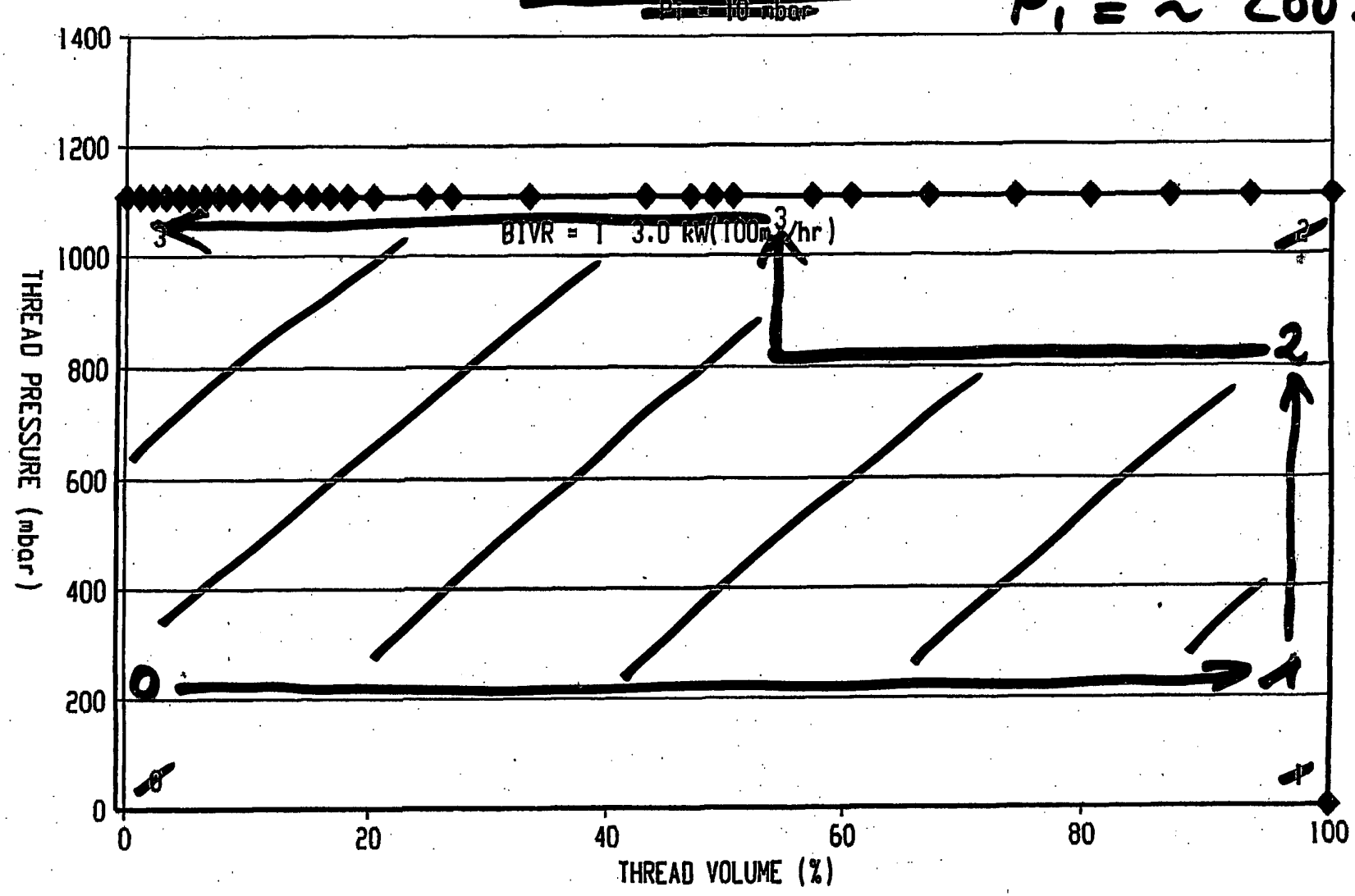


EXHIBIT A

two separate stages, each with

Kashiyama



WO 02/33262

EXHIBIT B

invention : 1st stage with internal compression,

2nd stage with [constant volume compression] Pi ≈ 200 mbar

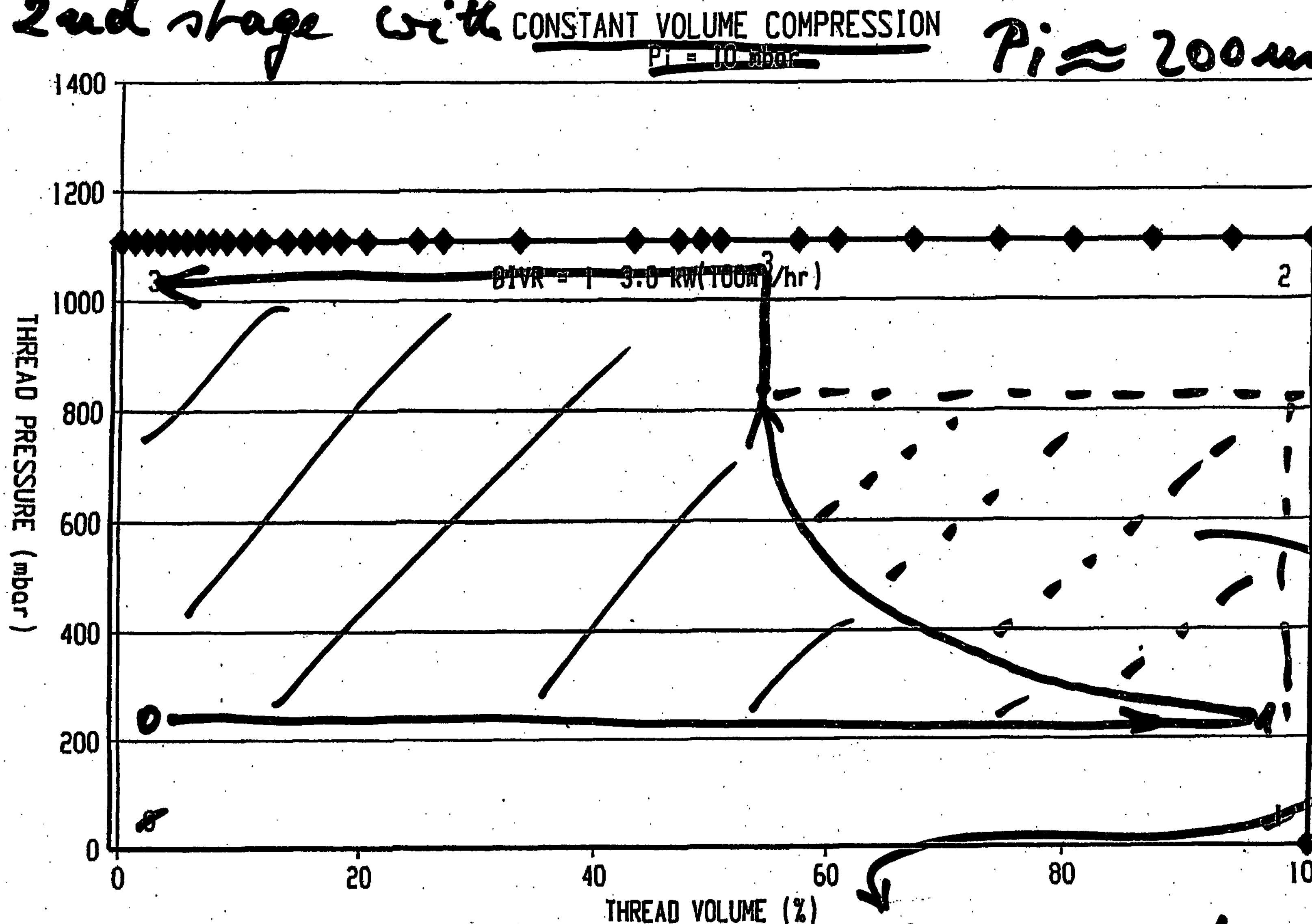


EXHIBIT C

power need saved, compared with [illegible]